Integration of Distributed Generation systems: A Review

[1]Vipin Chandra Bhatt, [2]Santosh Kumar Modi [3]Rahul Kumar Chauhan

[1] DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING,

SHIVALIK COLLEGE OF ENGINEERING, DEHRADUN

Abstract:- In this era, electrical energy plays a very important role in human life. The requirement of electricity increasing gradually. This is a summary concerning the integrating of distributed generation (DG*)*. The main focus on DG integration, especially on the renewable type, because non-renewable sources decreasing day by day and non-renewable sources are in limited quantity as coal , petroleum ,natural gas reserve etc. The paper also analyses the response in transmission system operation and development that result from the connection of large amounts of Distributed Generation of different energy conversion systems focusing on points associated with impacts in steady state procedure, contingency scrutiny, protection synchronization as well as dynamic behavior analysis. The Distributed generation is the most interesting technology now a days.
The Distributed generation is the solution of all electrical power need.

Index Terms— Distributed Generation, integration, renewable source, transmission, energy conversion, synchronization, analysis.

1. Introduction

Power systems are undergoing a significant change. Decarbonisation and technological development are increasing reliance on renewable technologies, primarily variable weather-dependent resources such as wind energy, solar energy, tidal energy, biomass and hydro power. Accommodating the relatively less controllable and predictable output of the new technologies is driving changes in the composition and operation of the entire power grid.

Balancing of generation and consumption at all times requires flexibility in the system. Traditionally, flexibility was provided in power systems almost entirely by monitoring the supply side and controlling the generation. Increasing reliance on variable renewable energy sources (VRES) for large fractions of the electricity production in power systems introduces new challenges to power system planning and operation. In this respect, increasing controllability and flexibility of the (variable) supply and of the demand is a key pathway towards a more robust system.

- *Vipin Chandra Bhatt has completed masters degree program in electric power engineeringfrom UTUDehradun, Uttarakhand, india, PH-9719369129. E-mail: vipinbhatt456@gmail.com*
- *Co-Author Santosh Kumar Modi is currently pursuing Batchler degree program in electric & electronics engineering from UTU, Dehradun, Uttarakhand, India, PH-7060472025. E-mail: rajsantosh98@gmail.com*
- *Co-Author Rahul Kumar Chauhan is currently pursuing Batchler degree program in electric & electronics engineering from UTU, Dehradun, Uttarakhand, India, PH-9012496429. E-mail: srick84666@gmail.com*

2.Distributed Energy Sources:-

2.1-Solar Energy

A plenty of solar energy source is motivation for us to covert this solar power into electrical energy. As we know that many of the country is focusing of this solar power generation because of very low maintenance and easy availability of solar power.
We can say that the running cost is almost negligible for this kind of energy generation.
Many of the country of the world is now increasing their generating capacity through solar power. In india like Rajasthan, Tamilnadu and Gujrat generating 90% energy from solar power.

2.2-Wind Energy

India is surrounding by Arabian sea in west and bay of Bengal in east so that power generation through Wind turbine is very easy in coastal region. India has 7517 km boarder with sea. Wind power generation is also possible in hilly areas where the speed of wind is high enough to rotate wind turbine. In remote areas of hill it is not easy to maintain wind power generation but it could be an option for distributed generation.

2.3-Hydle power

Hydro power generation is the main source of electrical energy in hilly areas as there are a nos. of micro small and mini hydro project in main river and tributaries. Indian Govt. is also enhancing different types of scheme like

UREDA in Uttarakhand and Providing loan and Subsidy through MSME etc. so that the generation of hydro power is most important. In uttarakhand most of small and micro hydro project which are under construction and some are in working and supplying electricity.

2.4-Tidal energy

In coastal areas where tide occurs we can use this tidal energy through high tide and low tide hydro power plant for generating Electrical power.

Scope of Tidal Energy in India

As we know – India shared boarder by sea on three sides that is a high opportunity to generate tidal energy. The three most important prospective locations in india are Gulf of khambat , Gulf of Kutch and Ganges Delta, Sundarbans, West Bengal. The most important locations are the Gulf of Cambay & the Gulf of Kutch in Gujrat where the tidal level is *11 m and 8 m* with average tidal range of 6.78 m and 5.24 m, respectively. The Delta of Ganges also has superior site for small size tidal energy. The highest tidal level in Sundarbans is around 5 m and an average of 2.97 m.

The predictable tidal power potential in India is 8000 to 9000 MW with about 7,000 MW in the Gulf of Cambay, almost 1,200 MW in the Gulf of Kutch and less than 100 MW in Sundarbans. The Kutch Tidal Power Project with an installed capacity of about 900 MW is projected about INR 1,460 cr generating power at about 90 paise/unit.

The West Bengal Renewable Energy Development Authority established NHPC Ltd. to examine detailed project report on Durghdhauni which is a mini Tidal Energy generation plant having installed capacity of 3.65 MW in the Sunderbans. The power plant, which was industrial by a mutual alliance between IIT, Madras and National Institute of Ocean Technology, Tamil Nadu, provides electricity about 15,000 houses.

Upcoming Projects of India

- 40 MW Wind Power Projects in Gujarat - **Industry :** Power Generation - **State :** Gujarat - **Project Stage :** Project Work Commenced
- 150 MW Captive Power Plant in Butibori, Maharashtra - **Industry :** Power Generation - **State :**Maharashtra - **Project Stage :** Environment Clearance Stage
- 6 MW Wind Power Project in Krunool District, AP - **Industry :** Power Generation - **State :** Andhra Pradesh - **Project Stage :** Project Work Commenced
- 2000 MW New Gas-Based Combined Cycle Power Unit in Gujarat - **Industry :** Power Generation -**State :** Gujarat - **Project Stage :** Pre Project Stage
- Rs. 900 Million Power plant Project in Kendujhar District, Orissa - **Industry :** Power Generation -**State :** Orissa - **Project Stage :** Environment Clearance Stage
- Rs.8552 Million New Hydel Power Plant in Uttarakhand - **Industry :** Power Generation - **State :**Uttarakhand - **Project Stage :** Environment Clearance Stage
- 50 MW Wind Power Project in Bijapur District of Karnataka - **Industry :** Power Generation - **State :**Karnataka - **Project Stage :** Project Work Commenced
- 100 MW New Solar Power Project in Uttarakhand to be Commissioned in Feb 2017 - **Industry :** Power Generation - **State :** Uttarakhand - **Project Stage :** Project Work Commenced
- Rs.650 Million Wind Power Project in Chitradurga district, Karnataka - **Industry :** Power Generation -**State :** Karnataka - **Project Stage :** Pre Project Stage
- Rs.4000 Millon Solar Power Project in Bhatinda, Punjab - **Industry :** Power

Generation - **State :**Punjab - **Project Stage :** Pre Project Stage

3. Challenges to increased penetration of DG

This is a challenging task to increased penetration of DG. That can be further classified into three important categories, like technical, commercial and regulatory.

3.1 Technical Effects of DG

3.1.1Voltage increasing consequences

The voltage rise effect is a major factor that confines the amount of further DG capacity that tied to rural distribution networks.

3.1.2 Power quality

The power quality is generally considered to be important in two aspects (a) transient voltage disproportion and (b) harmonic distortion of the voltage. Depend on circumstances DG plant can Increase or decrease the voltage quality received by additional users networks of the distribution system. Power quality is progressively more important subject and generation is generally focused to the same regulation of loads. This tends to work fine in practice and it is usually possible to meet up the required standards by vigilant design. The effect of fault level is increasing the by accumulate generation frequently leads to enhanced quality of power. A distinguished exception is that a single DG, such that a wind turbine, on a feeble network may enhance the power quality problems particularly during switching on and off.

3.1.3 Protection

A number of unlike aspects of DG protection be able to identify: Protection of the generation apparatus from internal failure; protection of the faulted part from high fault currents by DG; deviation of mains protection and effect of DG on distribution system's protection. All of these are significant and should be cautiously linking DG to distribution networks.

3.1.4 Stability

Conventionally, distribution network propose did not need to consider constancy as the network was idle and stable under most conditions the transmission network itself steady. Still stability is only just measured when we assess renewable distributed generation plan. However, this is expected to change the penetration of these plan further increases their involvement to security of network becomes better. The areas that need to be considered comprise transient as long as dynamic stability and voltage collapse.

3.2 Commercial Effects

Case studies have indicated that the supervision of distribution load can enable significant increases in the amount of DG that can be connected to the existing load. Although the cost associated with the operation of active distribution networks is still to be identified, it is expected that the benefits are likely to considerably outweigh the cost of its implementation. At present, however, distribution companies having wires businesses have no incentives to connect DG and offer active management services. In order to support the development of active distribution networks and extract corresponding benefits associated with connecting increased amount of DG, new commercial arrangements need to be developed.

Generally, there are three possible approaches:

To recover the cost of implement active organization directly through the price control machinery (increasing the amount of recoverable capital and operating expenses associated with active management). The cost recovery could be achieve through improved charges for the use of the net-works (imposed either to distributed generators benefiting from active management and/or demand customers).

To establish an enticement scheme that would reward companies for connecting DG, such as one recently developed in the United Kingdom . this incentive machinery, assuming a suitable design of the scheme, could lead to the development of active distribution networks. Such type of schemes could be funded from better charges imposed on generators and/or demand customers.

For establish a market system, outside of the regulatory structure, which would create a commercial environment for the development of active networks? Under this situation distribution companies would offer active management ser-vices to generators for a charge. Clearly, whenever the net benefit from active management exists, this could be used as a basis for mutual discussions between the local company and the generator.

4-How to improve power quality in distribution

Continuously the engineers and preachers are increasing the use of complicated different tools and software to get better procedure of the distribution planning.
Network data and secondary information has brought to new importance in the modern technology of the system of distribution network. As we know the new tools are powerful and can handle considerable amounts of information, it is clear that the planning and designing process needed some revamping because the practice of planning differed from area to area and inexperienced engineers due to lack of experience to interpret the software results.
As a result of this, a review of the planning was carried out and a convenient process comes close to has been developed. These are some corrective measures listed in order of priority of application and cover most situations:

1. Load Distribution
2. Load unbalance correction
3. Installation of Shunt capacitor
4. Replacement of Line conductor
5. Rebuilding a single or double phase segment of the supply into a 3-phase system
6. Installation of voltage regulators.

In all cases the order should not be consider absolute. It is possible to regulate more than one parameters on the same feeder to remove problems or for reduction of power losses of power loss.

Optimization approach is based to minimize distribution losses. Every parameter describe can return major loss decrease with the locating voltage based regulators. Losses calculated rapidly by using network software simulator. By trial and error, the best solution by collate simulated development versus actual situation. Distribution planning software regularly gives optimization functions for assisting in the task.

For measures as addition or replacing conductor, the optimization approach is based on the least cost of the solution; including all the costs and savings, loss reduction are taken into accounts. The listed corrective measures are described by following.

5. Conclusions

This paper gives an overview of distributed generation which is integrated with electric power systems. These issues are as important and convincing today, possibly even more so, A decade ago when distribution generation (DG) became accepted as an important subject in electricity supply. A general idea of the important challenges that essentially be overcome in the combination of DG into power supply has also been accessible. In this paper, particular prominence placed to change the planning of network and policies for operation is connecting DG to electric power arrangement to a new appropriate technology of integrating DG into planning of power system and function though active management of distribution electrical power networks.

A we know that ancient time in india water mil used in large scale but lack of maintenance and developing new technology these mills has been obsolete.Now days in india, there are many more hydro power project, thermal power project, nuclear power project contributing in electrical energy generation. Renewable source of enrgy also contribute in generation of electrical energy. So that traditional way of generate electrical energy.

UREDA is an agency which provide financial help for renewable energy resources that also motivate people in hilly areas to generate electricity at their own places and also provide self employment them. As we know that the demand of electricity is increasing regularly but the production is not on the way as required to meet the demand. So integrated distributed generation is the only way to meet the demand at al. there are many more resources to generate electrical energy depending on the area you live like solar power generation, generation through wind mills & water mills.

Now days water mill has been obsolete from the india. Water mill is smart way to generate electricity very easily with minimum initial and running cost. In the villages of hilly area in india , water mill was very popular way to generate electricity with synchronizing flour mill.

In regions where the DG techniques is hefty it is suggested to generation restriction, in general for only limited periods of time, in order to fulfill, when it is required the operation limits of security of transmission system. However, supervision of

Distributed Generation unit potential should be used to help manage the confined distribution network and the transmission system through the additional functionalities of DMS or by using the introduction of local generation dispatch control centers, which is to provide:

1. In order to provide power estimate; capacity of syndication of regularly DG production
2. ability to limit production injections in the transmission network by using local DG control;
3. if necessary system should be able to limit DG production ramping rates.
4. There should be a monitoring for reactive power support (technically feasible);
5. active power supervision reserves, thus enabling reductions in secondary reserves (which can be easily implemented in the present technology scenario).

As long as wind energy is affined and the production curtailment is predetermine, it would be necessary to develop integrated generation solution, where the electrical wind energy reduced for the load could be and later supplied in the line during time of low wind speeds. If situated in large industrial and inhabited areas, DG has noteworthy benefits as it reduces the need for lying new

transmission line. These investments have to be calculate carefully.

Transmission lines and installing new transformers and protection equipment. In rural areas connected through weak network the increase in DG will require extra investments in

References

CIRED Working Group WG04, Dispersed Generation, June 1999.

CIGRE Working Group WG 37-23, Impact of increasing contribution of dispersed generation on the power system, 1997.

COM (97) 559, Communication from the European Commission: energy for the future, renewable sources of energy, White Paper for a Community Strategy and Action Plan. European Commission, Directive of the European Parliament and the Coun-cil on the Promotion of Electricity from Renewable Energy Sources in the Internal Electricity Market, 2000.

N. Hatziargyriou, A. Zervos, Wind power development in Europe, Proc. IEEE 89 (12) (2001) 1765–1782.

Wind Directions, vol. XXII, No. 1, November 2002.

Ofgem, Electricity distribution price control review Appendix—Further details on the incentive schemes for distributed generation, innova-tion funding and registered power zones, June 2004 http://www.ofgem.gov.uk/ofgem/work/index.jsp?section=/areasofwork/distpricecontrol.

N.D. Hatziargyriou, T.S. Karakatsanis, M. Papadopoulos, Probabilistic load flow in distribution systems containing wind power generation, IEEE Trans. Power Syst. 8 (1) (1993) 159–165.

N. Hatziargyriou, T. Karakatsanis, G. Strbac, Connection criteria for renewable generation based on probabilistic analysis, in: Sixth Interna-tional Conference on Probabilistic Methods Applied to Power Systems, PMAPS'2000, Funchal, Madeira, Portugal, September 25–28, 2000.

EC Contract JOR3-CT98-0201, Final Report, Electricity Tariffs and Embedded Renewable Generation, July 2000.

N. Jenkins, R. Allan, P. Crossley, D. Kirschen, G. Strbac, Embedded Gen-eration, IEE Power and Energy Series 31, London, 2000.

Ilex Energy Consulting with the Manchester Centre for Electrical Energy, UMIST, A report for DTI on Ancillary Service Provision from Distributed Generation, September 2004, URL: http://www.dti.gov. uk/renewables/publications pdfs/dgcg000300000.pdf.

J. Pec¸as Lopes, Integration of dispersed generation on distribution networks—impact studies, in: Proceedings of the IEEE Winter Meeting, N.Y., February 2002.

P. Smith, H.K. Clark, Impact of increasing wind generation on the trans-mission system in the Republic of Ireland, in: Proceedings of the CIGRE Symposium Neptune 1997, Romania, 1997.

T.P. Leao,˜ M.A. Matos, Distribution Planning with Fuzzy Loads and Inde-pendent Generation, in: Proceedings of the 14th International Conference and Exhibition on Electric Distribution, 1997.

P. Kundur, Power System Stability and Control, McGraw-Hill, 1993.

J.G. Slootweg, S. de Haan, H. Polinder, W. Kling, Modeling new genera-tion and storage technologies in power system dynamics simulations, in: Proceedings IEEE Summer Meeting, Chicago, July 2002.
J. Machowski, J. Bialek, J. Bumby, Power Systems Dynamics and Stability, John Wiley & Sons, 1997.

J.G. Slootweg, W. Kling, Impacts of distributed generation on power system transient stability, in: Proceedings of the IEEE Summer Meeting, Chicago, July 2002.
R. Allan, G. Strbac, P. Djapic, K. Jarrett, Methodology for developing ER P2/6, DTI Report, April 2004.